1907MNRAS..67..487L

On the Presence of Tin in Stellar Atmospheres. By Joseph Lunt, B.Sc., F.I.C., Assistant at the Royal Observatory, Cape of Good Hope.

During the course of measurements of stellar radial velocities, Mr A. W. Goatcher happened to measure a line at ± λ 4525 on 14 negatives of the spectrum of α Scorpii. He pointed out that the line in question was markedly discordant, giving a velocity which was more than 6 kilometres per second too low (positive) in the mean, when the wave-length of the stellar line was assumed to be λ 4525·285, corresponding to a blend of the two lines in Rowland's tables at λ 4525·110 Int 0, origin unknown, and λ 4525·314 Int 5, due to iron.

On searching for some cause for this pronounced discrepancy, I found that a strong tin line occurred on the ultra-violet side of the iron line.

Exner and Haschek place its wave-length at λ 4525·00 Int 30, and they give another line at λ 4585·80 Int 20, but they record no other lines brighter than intensity 1 in the region covered by the Cape 4 prism spectrograph.

On taking photographs of the spectrum of tin, with electrodes of the pure tin "fuse wire" ordinarily used in electrical circuits, it was found that whilst the λ 4525·00 line came out strongly, the λ 4585·80 line was entirely absent, and in fact no other line appeared except a faint line at λ 4227 due to a trace of calcium.

This was due to the fact that self-induction was used in the secondary circuit of the 18-inch spark induction coil, as is usual in producing the iron spark as a source of the comparison spectrum for our stellar spectra.

On eliminating the self-induction, the λ 4585·80 line came out much more strongly than the λ 4525·00 line, differing in this respect from Exner and Haschek's relative intensities; but with the exception of air lines no other lines of importance appeared.

The line of lower refrangibility is, in fact, the strongest enhanced line of tin recorded by Lockyer, whilst the λ 4525 line is absent from his list of enhanced lines.

It is evident that the λ 4585 line is not likely to occur in the cooler stars such as α Scorpii, and we are reduced to a single line in our 4-prism region in searching for evidence of the presence of tin in these stars.

The tin line from the "fuse wire" was carefully measured and gave the wave-length λ 4525·01, which shows that it is more likely to coincide with Rowland's solar line λ 4525·009 Int 00 than with the line closer to the iron line, viz. λ 4525·110 Int 0.

If we assume that the Sn and Fe lines have the intensities 3 and 4 respectively in α Scorpii instead of 00 and 5 as in the Sun, and wave-lengths λ 4525·009 and λ 4525·314, according to Rowland's solar wave-lengths, we can well represent the stellar line, which as a blend would then have the mean wave-length λ 4525·183.

1907MNRAS..67..487L

Photographs of the tin and iron spectra taken on the same plate show the blended lines as a single unresolved broad line with the dispersion employed, just as is shown in the stellar spectra.

We must therefore conclude that, so far as our limited range of spectrum is concerned, a line corresponding to the one and only line of tin which seems likely to occur in the cooler stars is certainly present, and further confirmation of the existence of this metal in stars should be looked for outside the region of spectrum here considered, particularly in the region of longer wave-lengths.

Professors Hale and Adams[*] have secured with the Snow telescope a spectrum of α Orionis which extends to λ 5703·73. It will be of much interest to ascertain whether the arc line of tin in the yellow region at λ 5631·91 (Kayser and Runge) is shown in their photograph of the spectrum of this star. It occurs in a region of the solar spectrum which is free from strong lines or groups. It is shown as a strong line in Hagenbach and Konen's Atlas, and has also been recorded by Huggins, Thalén and Lecoq de Boisbaudran.

In the Harvard Annals a line is recorded at λ 5632·0 as being stronger in α Orionis than in the Sun, α Aurigæ and α Boötis.

The star line at λ 4525 has been used in radial velocity determinations, once by Frost[†] in β Leporis and once by Belopolsky[‡] in γ Cephei, and in each case the line gives a lower result than any other on the plate. These two stars belong to classes G and K respectively, according to the Harvard classification, and the discordance of the tin-iron line is therefore likely to be less marked than in α Scorpii.

The recorded evidence of the presence of tin in the Sun appears to be very meagre and doubtful.

In "Rowland's table of solar elements,"[§] arranged according to number of lines associated with them, tin appears at the end of the list amongst elements showing only one or two coincidences between the lines of their spectra and solar lines.

In Rowland's "Preliminary table of solar spectrum wave-lengths," the only references to Sn seem to be the following three lines:—

Rowland's.			Kayser and Runge (arc).		Exner and Haschek (spark).	
λ	Int.	Origin.	λ	Int.	λ	Int.
3262·409	3	Fe-Sn	3262·44	2	3262·48	30
3330·745	000	Sn?	3330·71	3	3330·83	6
3801·163	000	Sn?	3801·16	3	3801·32	20

These are outside the 4-prism region of the Cape Spectrograph, and no photographs of star spectra are here available to search for these lines in the spectra of the cooler stars.

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[*] *Ap. J.*, vol. xxiii. p. 400.

[†] *Ap. J.*, vol. xviii. p. 257.

[‡] *Ap. J.*, vol. xix. p. 101.

[§] *Problems in Astrophysics*, Clerke, p. 27.

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1907MNRAS..67..487L

Note on the Range in Brightness at Maximum of Long-period Variables. By H. H. Turner, D.Sc., F.R.S., Savilian Professor.

1. In an interesting letter dated April 16, commenting upon the paper "On the Classification of Long-period Variable Stars, etc." (*Mon. Not.*, lxvii. p. 332), Mr C. L. Brook draws attention to the possibility of explaining the well-known differences between separate maxima in terms of the hypothesis put forward in the paper. His words are as follows:—

"Not only does the amount of solar disturbance vary greatly at different Sunspot maxima, but also the two hemispheres differ to a considerable extent. . . . Now if the Sun were viewed poleward instead of equatorially, the effect of this would be to further increase the difference that already exists in the intensity of the various maxima: we should either see the whole of the then more disturbed hemisphere or the whole of the less disturbed hemisphere, and not as now half (about) of each. If then the analogy between the Sun and the long-period variables holds in this particular, then the maxima of those variables which we view polewards should differ to a greater extent in intensity than the maxima of those which are viewed equatorially."

2. A rough test of the interesting corollary indicated by Mr Brook is simply made. On pages 351 and 352 of the paper above quoted are two lists of twenty stars from Chandler's Revised 3rd Catalogue which should be (on the hypothesis put forward) stars viewed polewards and stars viewed equatorially. We need only take from Chandler's 3rd Catalogue (*A.J.*, 379) his tabulated range of magnitude at maximum (not repeated in the Revision, *A.J.*, 553). Thus for X Ophiuchi (No. 6682), Chandler gives the magnitude at maximum as 6·8–7·0, or a range of 0·2 magnitude; and in most cases he gives figures of this kind; while the range is often much larger, as for *o* Ceti (No. 806), where he gives 1·7–5·0, a range of 3·3 magnitudes. In a few cases he gives a single value only, as for RS Libræ (No. 5511), where he sets down 8·2 simply: and in the subjoined table the range has in such cases been set down as 0·0; for though further observations may show an appreciable range, it will no doubt remain small.

3. The following table will be understood without further explanation; means have been taken for each ten stars, and it will be seen that for the extreme groups of ten the difference in range is quite marked, but is *in the opposite sense* to that suggested by Mr Brook.

4. It is not, however, impossible to frame an explanation of this table in terms of the hypothesis put forward. If the variations in the two hemispheres are related by some system of alternation—if, for instance, the total quantity of bright, flocculous matter on the star at maximum were always the same, but distributed for the greater part sometimes in one hemisphere and sometimes in the other—then the view enunciated by Mr Brook is the correct one.